

How to Prepare a Writeup on Laboratory Exercises

Purpose:

This handout is provided to the student as guide to scientific writing. It specifically addresses the recording of experimental results and the writing of laboratory reports. For purposes of this course, the student will treat the laboratory exercises as original research. It is not within the scope of this course to improve the student's writing ability. Neither brilliant nor clever writing is needed. However, proper clarity and grammar are required. Scientific writing is functional and, indeed, sometimes dull. Its function is to relay complete and accurate information as concisely as possible. The report should be short but complete and the attached format is recommended. Note: Not all of your experiments will require a full report! Read the individual laboratory instructions carefully.

Report Format:

The report should contain six parts. These are:

1. the "Abstract" which is on a separate page,
2. the beginning or "Introduction",
3. the "Experimental Methods" which would normally include your experimental plan,
4. the "Experimental Results" which must include all of you experimental data,
5. the "Discussion" which presents the implications of this research and
6. the "Conclusion."

The report should also have a **separate title page** with:

1. the title,
2. the author's name,
3. the date of the report,
4. the institution where performed (for example "Roane State Community College")

Each of the sections must be identified with a clear heading. Each of the words below that are underlined should appear as section headings in the report

The Abstract*

An abstract or summary is required. The primary purpose of the abstract is to allow rapid scanning by potential readers. It should be concise, inclusive, easily comprehended and include the major conclusions. The abstract should also be a separate page and include at the top of the page the same information that is on the title page.

The Introduction*

The introduction includes:

1. the purpose of the report and/or the justification for the research performed. A simple statement can sometimes break the writer's block: "The reason for this report is . . ." or "The purpose of the research. . . ." Neither of these statements is eloquent, but they give you a beginning. Rewrite later if you wish.

2. The scope of the report, what is and what is not covered, should be included.
3. Include any necessary background material such as reference to prior work discussed in the text.
4. A summary of theory and basic principles known prior to the report (appropriate references are required for this) is usually appropriate.
5. If the report has a format different from the one outlined here, an explanation of this particular organization is needed.
6. Include definitions of terms not commonly used and define the terms central to the particular experiment.

The Middle Section:

This section can vary considerably depending on circumstances. The information included in this section consists of:

Presentation of Experimental Methods* (or "Experimental")

Materials Used:

Describe all materials used. Give the purity, size, shape and any other variables which may be relevant. Retain in your original records all information, observations, data, etc., you collected from the very start of the experiment. When the research is completed, variables originally thought to be irrelevant may be vital. It may not be appropriate to report some of them in this section. Data related to materials, however, are relevant in this section. If some property is suspected to be relevant but unknown or unobtainable, indicate this in the report.

Instrumentation:

Describe all instruments used. This usually requires only the instrument name, model number and/or type. Fully describe any modifications to the conventional configuration of the instrument. This may require engineering or schematic drawings. Include such drawings in the report as figures.

Experimental Procedure:

Tell how each experiment was performed. Ideally, the researcher obtains a notebook and uses it to record each experimental step and observation. Each step and observation must be reported in sequence. Experiments are often repetitive in nature. It is not necessary to describe the details of the common experiment with every variation. Describe the experiment in detail for the first experiment. In subsequent research using the same procedure, it is not necessary for the researcher to repeat the description. The researcher indicates the common experiment as a point of reference. Next the researcher describes in detail the variations on this common experiment. Each variation should be given some name or other form of identification (Run 1, Run 2, etc.). These variations are usually listed in a table for easy reference.

Experimental Results* (or "Results")

In this section all observations, both qualitative and quantitative, are presented. In an effort to make the results more easily understood, refer to figures, tables, photographs, etc.

All observations and data should be recorded in "raw" form (data which has not been massaged or transformed) in a notebook as a permanent record.

*What is "data"? At the very minimum you must record and report any value you obtain from any instrument you use. Other necessary data might be observations, such as color, etc.

If the data given in the report is transformed mathematically from the original data, the method of transformation should be clearly noted under "Experimental Methods" section. Never present data in such a manner that information is lost. The original data should be calculable from the transformed data. For example, if you report the density of a material, you should also give the weight or the volume and preferably both.

Discussion* of Results

Often this section is included in "Experimental Results", especially if the results portion is short. If you do this then modify the "Experimental Results" heading to "Experimental Results and Discussion".

This section is an explanation of the experimental results. This includes formulations of new theories, reconciliation to previous work and resolution of any internal conflicts. Give the implications of the research. A discussion of possible future research which might be needed is appropriate.

The Conclusion*

The conclusion should be brief. It should include the significance of the research vis-a-vis the justification for the research in the introduction. This tends to tie the work together. Include a very brief summary and the main inferences as reported in the discussion. It may include a statement of planned future research. Do not introduce any new information in the conclusion.

Other Material for the Report

Acknowledgments

This is included here for completeness. In the chemistry course it is not necessary. Acknowledgments are used to recognize funding agents and persons that have been a special help in facilitating the research. This latter might be someone whose lab or equipment was used.

Figures and Tables

Provide captions (titles) for all figures, photographs, and graphics. These should be self-explanatory if possible. Many readers skim articles by reading the abstract, the conclusion and the figure captions. Therefore, captions should be clear and concise. An expert should not be

required to refer to the text in order to understand the figure. Captions can be as long as three sentences in order to fulfill this requirement. Graphs should have all axes clearly labeled with a few words and the appropriate units. Use the SI (IUPAC) convention for units with the “/” so:

	Description / units
Examples:	distance / m
	time / ms
	wave length /nm

Notice that it is convenient to use prefixed units. This allows the use of number between 1 and 999 for axis labeling. This avoids the use of scientific notation for the labels.

Tables are labeled in the same manner as figures. The title fulfills the same requirements as the figure caption. The column headings fulfill the same requirements as the axes labels.

Tables and figures are included in the text of most articles. However, in reports it is common to include them after the references. This latter approach should be followed in this course.

Appendices

Avoid appendices unless they provide easier reading in the main body of the text. The material contained in the appendices should be relevant but not necessary in order to understand the main body of the text. An appendix is always referenced in the main body of the text.

References

The conventions on the form of references vary, but should be consistent within the report. Either the style given in the American Chemical Society Handbook for Authors or the Harbrace Handbook or other styles handbook is suggested. Each journal or publisher has a preferred style.

Failure to mention a reference in the text is prima-facie evidence that the reference is unnecessary and should not be listed. Use of ideas, wording, equations, etc. from another's writing without a reference is plagiarism (whether deliberate or inadvertent).

Some Comments on Writing Style:

Positive short statements are preferred. Adhere to this even at the risk of making the text sound choppy. Break up complex sentences. Use simple tenses.

Tenses (and voice) create many problems in scientific writing, probably due to an obsession of scientists to avoid the first person. A safe rule is to use the simple present tense although observations are usually listed in the past tense. A good illustration of exclusive use of the present tense is a typical cookbook which is in the imperative. This writing style is not eloquent, but it is safe. The passive voice is also recommended. Both the active and passive voices are permissible and are often mixed. (The beaker of water was placed over the flame and the water boiled. Notice, however, that water is a totem.) The reason that the passive voice is acceptable

in scientific writing is that the researcher should not matter in terms of outcome. (The author's name is on the report so due credit is given.)

Mixing tenses is common in scientific writing; however, there must be a reason for this. Again simple tenses are preferred. Care should be taken in the use of present tense and past tense. Selection should be deliberate. Example: "This theory states that. . . To confirm this theory, the gas was expanded. . . Gases bubbled from the beaker bottom."

Notice that the words "I", "we" and "you" (false imperative) are forbidden words in formal scientific writing. (This may not be true for informal writing such as "Scientific American".)

See Table I for a summary of tenses, voices and moods used in scientific writing.

Table I - Verb tenses, moods and voices acceptable in scientific writing.		
Section	Recommended verb type	Forbidden tense or words
Abstract	<ul style="list-style-type: none"> • Passive voice, past or present tense • Active indicative totem past tense 	<ul style="list-style-type: none"> • I • we • you
Methods	<ul style="list-style-type: none"> • Passive voice, present or past tense • Imperative mood not mixed with past 	<ul style="list-style-type: none"> • I • we • you
Results	<ul style="list-style-type: none"> • Past indicative passive voice or active totem • Subjunctive mood if appropriate 	<ul style="list-style-type: none"> • I • we • you
Discussion	<ul style="list-style-type: none"> • Past indicative passive voice or active totem • Present indicative especially relating to theory 	<ul style="list-style-type: none"> • I • we • you
Conclusion	<ul style="list-style-type: none"> • Past indicative passive voice or active totem • Present indicative especially relating to theory • Future indicative passive voice • Subjunctive past, present and future 	<ul style="list-style-type: none"> • I • we • you

The usual rules of paragraphing should be followed. In this spirit, remember that a simple train of thought (from a reader's point of view) uses no more than a half of a double spaced page. Count the number of paragraphs on each page. If you have less than two paragraphs, you are probably not paragraphing correctly or you are not being concise within each paragraph.

The Format:

IMPORTANT !!! : The words that are underlined should always appear in the report as headings in this course. For example, the word "ABSTRACT" should appear as the heading of the abstract.

Title Page
Title of Report
Name of Author
Where and when submitted Sponsor

Abstract

Title of Report Name of Author Body of the Abstract

Title of Report

Name of Author

Introduction

Experimental Method

Experimental Results

Discussion

} Or combined Experimental Results and Discussion

Conclusion

Acknowledgments*

Appendices*

References*

Figures and Tables[‡]

Figure Captions or Table Titles Axes labels or column and row names

On the next two pages is a shortened form of the grading sheet. Items marked with an asterisk (*) must be present as section titles. If not present the section is assumed missing. **NO** credit for missing sections.

* Optional

[‡] Normally included in the body of an article. For lab reports figures and tables are to be included at the end of the report

Lab report by: _____ Overall grade: _____ %

Name of Lab: _____

Section:	Points	Is this covered?
Overall Organization	5%	_____ %
General - See comments		<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> dna
Sections labeled	– (section value) %	<input type="checkbox"/> yes <input type="checkbox"/> no
Title Page OK		<input type="checkbox"/> yes <input type="checkbox"/> no
Grammar	5 %	_____ %
Abstract*	10 %	_____ %
Does it tell what was done?		<input type="checkbox"/> yes <input type="checkbox"/> no
Does it summarize the results?		<input type="checkbox"/> yes <input type="checkbox"/> no
Does it give implications?		<input type="checkbox"/> yes <input type="checkbox"/> no
Is it useful for scanning?		<input type="checkbox"/> yes <input type="checkbox"/> no
Is it useful for searching?		<input type="checkbox"/> yes <input type="checkbox"/> no
Introduction*	10 %	_____ %
Are new terms defined?		<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> dna
Does it give the reason for the report?		<input type="checkbox"/> yes <input type="checkbox"/> no
Does it give background?		<input type="checkbox"/> yes <input type="checkbox"/> no
Is the scope given?		<input type="checkbox"/> yes <input type="checkbox"/> no
Is other relevant literature cited?		<input type="checkbox"/> yes <input type="checkbox"/> no
Is theory presented?		<input type="checkbox"/> yes <input type="checkbox"/> no
Experimental Methods*	20 %	_____ %
Are all tools and instruments described?		<input type="checkbox"/> yes <input type="checkbox"/> no
All materials described with specifications?		<input type="checkbox"/> yes <input type="checkbox"/> no
Is data acquisition method described?		<input type="checkbox"/> yes <input type="checkbox"/> no
Are all the experimental steps described?		<input type="checkbox"/> yes <input type="checkbox"/> no
Are all mathematical manipulations given?		<input type="checkbox"/> yes <input type="checkbox"/> no
Are all figure and tables included?		<input type="checkbox"/> yes <input type="checkbox"/> no
Are all deficiencies discussed?		<input type="checkbox"/> yes <input type="checkbox"/> no
Experimental Results*	15 %	_____ %
Are all the data (numbers) given?		<input type="checkbox"/> yes <input type="checkbox"/> no
Are all figures of data included?		<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> dna
Are all transformed data listed?		<input type="checkbox"/> yes <input type="checkbox"/> no
Discussion of Results*	15 %	_____ %
Are encountered problems reconciled?		<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> dna
Are results reconciled to theory?		<input type="checkbox"/> yes <input type="checkbox"/> no
Are the implications described?		<input type="checkbox"/> yes <input type="checkbox"/> no
Is other work suggested?		<input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> dna

Conclusion* 10 % _____ %
 Does it tie back to the Introduction? yes no
 Does it give inferences? yes no
 Does it summarize the results? yes no
 Does it suggest future work? yes no dna

Tables , Figures, Drawings, Photos, Appendix ≥5 % _____ %
 Are the captions or titles descriptive? yes no dna
 Are the captions or titles appropriate? yes no dna
 Are the axes (columns) labeled? yes no dna
 Are the units correct? yes no dna
 Are the figures clear? yes no dna
 For drawings, are parts labeled? yes no dna
 For photos, are features highlighted? yes no dna
 For photos, is a scale included with each? yes no dna
 For appendix, is the use proper? yes no dna

References 5 % _____ %
 Is each relevant? yes no
 Are all noted in the text? yes no
 Are all relevant references? yes no
 Is each form correct? yes no

Late? yes no

How late? _____ -20 % / week = _____ %

Cheating? (See comments) - a lot % yes no

COMMENTS:
